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(54) **Safety relief valves**

(57) Process and apparatus for testing in situ the set pressure of a safety relief valve which comprises providing a supplementary force to that exerted by an operating pressure which acts counter to a valve loading means and which is of such a magnitude that it causes the safety relief valve to open. The supplementary force may be provided by spring or fluid means.

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FIG.1.

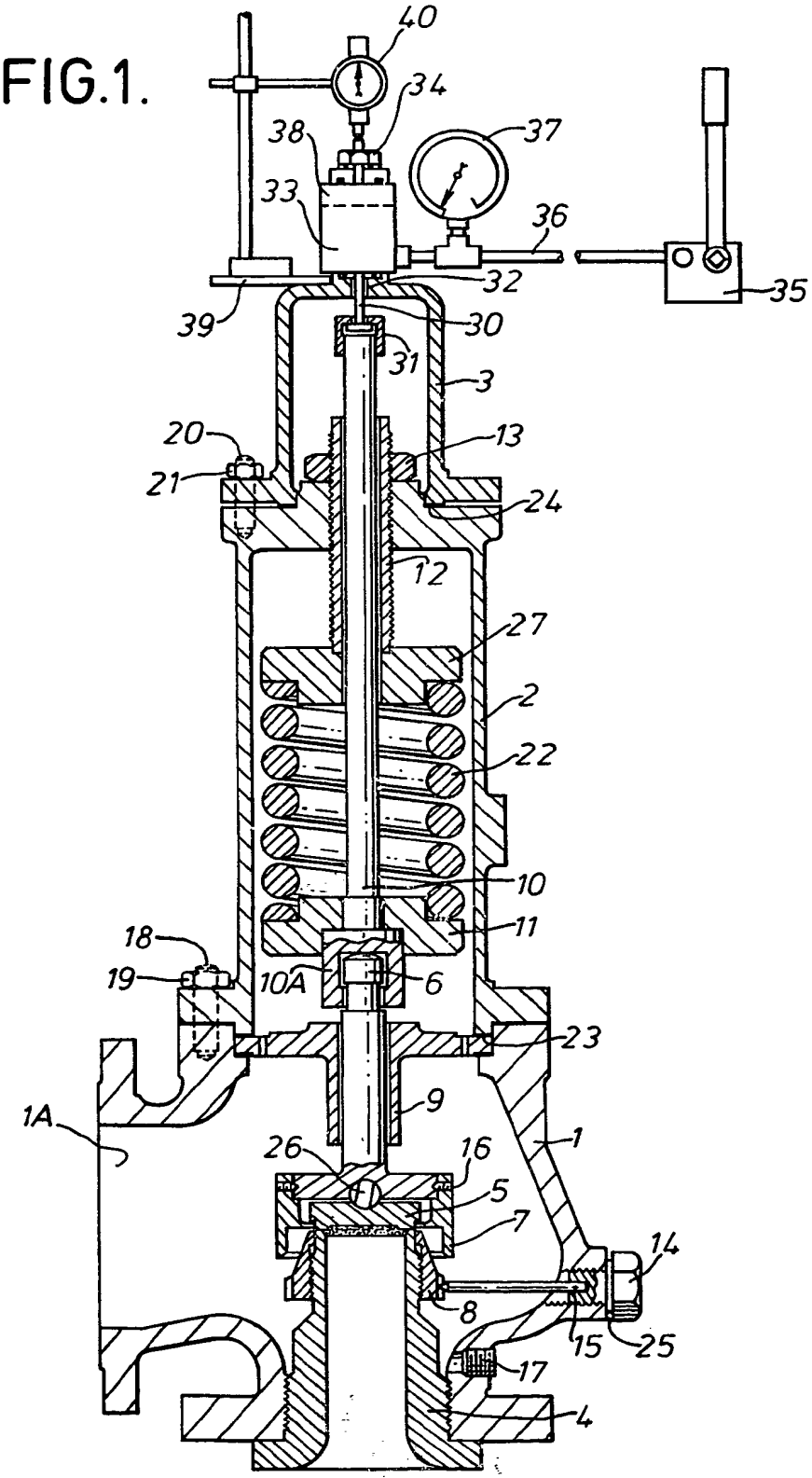
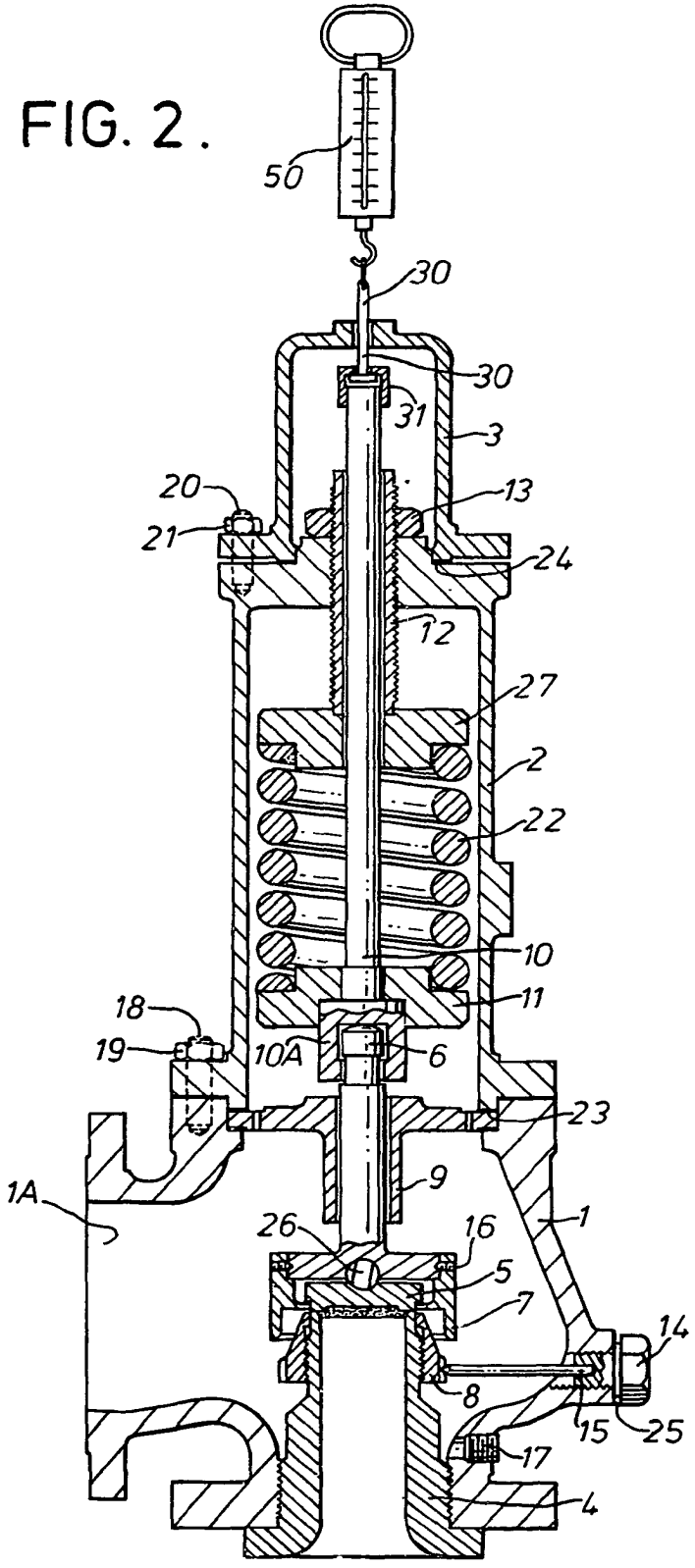


FIG. 2.



SPECIFICATION

Safety relief valv s

This invention relates to safety relief valves and is particularly concerned with the inspection and correct operation of such valves.

Recent legislation in many countries relating to health and safety in factories and the like has meant that much greater emphasis has now to be placed on the need to verify that safety relief valves are functioning correctly, especially in the chemical and general process industries.

The removal of safety relief valves from plant, in order to verify that they are in correct working order is a very expensive procedure. Normally the set pressure of the valve, ie the pressure at which a valve will open, can only be verified when the plant is closed down. As most industrial plants run on a continuous basis for long period of time such a procedure is expensive in down time of the plant and additional equipment is therefore generally required by way of interlocked isolating valves and more than one safety valve; the additional safety valve acts as a standby unit against the time when one valve is removed for inspection and possible repair. However the expenditure incurred in the provision of such additional valves is considerable, and the present invention seeks to obviate this disadvantage by the provision of a new method of verifying the set pressure of safety relief valves.

The present invention provides means whereby the set pressure of the safety relief system can generally be verified when the system including the safety relief valve is subject to the normal operating pressure.

Pressure, by definition, is force divided by area, and the present invention seeks to measure the force component, the area component (in this case the sealing area of the safety valve seat) being known. In considering a safety relief valve which is already under pressure, the force which the present invention seeks to measure is the difference between the force exerted by the safety relief valve loading means, usually a spring, and a counteracting force exerted by the presssure within the pressurised system including the safety relief valve and acting on the sealing area of the safety relief valve seating components.

The present invention applies a further load acting counter to the spring load, and of such a magnitude that it will cause the safety relief valve to open. By dividing this force by the sealing area of the seating components, a pressure is obtained. This pressure must be added to the pressure appertaining at the time the test is carried out within the protected system, the sum of these two pressures being the set pressure of the safety relief valve.

The opening of the safety relief valve can be verified by either seeing, hearing, or measuring the movement of the valve spindle, or any combination thereof.

According to one aspect of the invention, there is provided a process for testing and verifying in situ the set pressure of a safety relief valve when the safety relief valve is subject to an operating pressure of a container or system, which comprises providing a supplementary load to that exerted by the operating pressure which acts counter to a valve loading means and which is of such a magnitude that it will cause the safety relief valve to open.

Preferably, the valve loading means of the valve comprises a spring. Furthermore the supplementary load is preferably provided by a hydraulic pump and means are provided for measuring this supplementary load. If desired, the supplementary load may be provided by alternative means such as pneumatic means.

A preferred embodiment of this aspect of the invention provides a process for testing and verifying the set pressure of a safety relief valve comprising the steps of applying an extension member to the spindle of the safety relief valve, applying a test cap over said extension member such that the extension member projects through said cap, applying a hollow hydraulic cylinder to that portion of the extension member which projects beyond the test cap, and retaining said cylinder on said extension member, attaching a force measuring device to said hollow hydraulic cylinder, and attaching a hydraulic pump to said hollow hydraulic cylinder and force measuring device, whereby the operation of said hydraluic pump, a force is built up within the hollow hydraulic cylinder, which is registered on the force measuring device, the applied force being increased until the safety relief valve opens so as to indicate the set pressure of the valve. The force measuring device can be, for example, a general calibrated measuring gauge or an electronic load cell or a direct reading spring balance.

According to another aspect of the invention, there is provided apparatus for testing in situ the set pressure of a safety relief valve which comprises fitting to a spindle of the valve means for applying a suplementary force in excess of that exerted by the normal operating pressure of the container or system to which the valve is to be fitted and means for measuring the magnitude of this supplementary force required to overcome the set pressure of the valve.

Again it is preferred that the valve loading means which provides the set pressure comprises a spring; in addition the supplementary force is preferably supplied by a hydraulic pump but may be provided by other means such as pneumatic means.

A preferred embodiment of this second aspect of the invention provides apparatus for

testing and verifying the set pressure of a safety relief valve, when the safety relief valve is subject to a normal operating pressure in a system containing the safety relief valve, said safety relief valve having its spindle fitted with an extension member to which is fitted a test cap through which the extension member projects, a hollow hydraulic cylinder being applied to that portion of the extension member which protrudes through the test cap and being retained thereon by retaining means applied to said extension member and a force-calibrated measuring device being attached to the hollow hydraulic cylinder, said hydraulic cylinder and measuring device, being connected to a hydraulic pump. Again, the measuring device can be, for example, a general measuring gauge, load cell or direct reading spring balance.

Preferably, the extension member will be screwed ontol the valve spindle; in addition, the hollow hydraulic cylinder will generally be of known cross-sectional area and have low friction properties.

The retaining means will preferably be in the form of a retaining nut which is screwed onto the spindle extension member such that it does not quite contact the hollow cylinder.

Preferably, the hydraulic pump will be hand operated and will be attached to the hollow hydraulic cylinder and force measuring gauge by flexible means, for example, a flexible hose.

Where a load cell is used as the force measuring gauge, such load cell will preferably be of the electronic type, and will be located either above or below the hollow hydraulic cylinder and will be used in conjunction with a digital or gauge type load indicator.

In order that the invention may be more readily understood, reference will now be made by way of example only, to the accompanying drawings, in which:—

Figure 1 is a cross-sectional elevation of a safety relief valve of the invention, and

Figure 2 is a view similar to Fig. 1, but showing an alternative embodiment of the invention.

Referring to the drawings, and firstly to Fig. 1, the safety relief valve shown comprises a cast steel body 1 to which is secured a casing 2. Located in the bottom (in the drawing) of the body 1 is a nozzle 4, the upper end of which provides the seating for the valve disc 5 which is carried by and movable with a reaction hood 7 mounted on the lower end of a disc holder 6 and said valve disc 5, a groove being provided in the valve disc. The valve disc 5, disc holder 6 and reaction hood 7 are connected to the spindle 10 of the valve through a stirrup 10A carried on the lower end of the spindle 10.

Mounted about the valve spindle 10 is a valve spring 22 which provides the set pressure of the valve and which is located between upper and lower spring caps 27 and 11 respectively, the upper spring cap 27 being carried by a compensating screw 12 passing through the upper end of the casing 2 where it is engaged by a locking nut 13.

The casing 2 is secured to the body 1 by means of nuts and screws—each being indicated respectively by reference numerals 19 and 18—gaskets located between the mating faces of the casing and body.

The nozzle 4 carries a blow-down ring 8 whose position relative to the nozzle 4 is adjustable by means of a setting screw 14/set screw 15.

Flow through the valve is "in" through nozzle 4 and out through outlet orifice 1*A* when the set pressure of the valve—as determined by the valve spring 22—is exceeded.

For the purposes of the present invention, ie for testing and verifying the set pressure of the safety relief valve, when the safety relief valve is subject to normal operating pressure in a system containing the safety relief valve, the valve spindle 10 on an upper threaded end thereof is provided with a spindle extension member which is secured to said spindle 10 by means of a security nut 31 threaded onto the upper end of the spindle 10 and which projects upwardly through an axial hole 32 in a test tap 3 secured to the upper end of valve casing 2 by casing studs and nuts, one each being indicated respectively by reference numerals 20 and 21. The spindle extension member 30 projects into and through a hollow hydraulic cylinder 33, the end of the spindle extension member 30 being engaged by a retaining nut 34 which is positioned such that it does not quite contact the hollow hydraulic cylinder 33.

A hydraulic hand pump 35 having a decompression valve is connected via a flexible hose 36 to the hollow hydraulic cylinder 33, a force-calibrated pressure gauge 37 being positioned in the flexible hose.

If desired or preferred, the force calibrated pressure gauge 37 may be substituted by an electronic lead cell located above or below the hollow hydraulic cylinder 33—such a cell 38 is shown in the drawing positioned above the hollow hydraulic cylinder—which will act in conjunction with a digital or gauge-type load indicator, not shown.

By operating the hydraulic hand pump 35, a force is built up within the hollow hydraulic cylinder 33—the fluid passing via flexible hose 36 which is registered on the force measuring gauge—the pressure gauge 37 or the load cell 38—the force being increased until the spindle extension member 30 raises the spindle 10 and hence the valve disc 5 so as to indicate and/or verify the set pressure of the valve.

In cases where it is necessary to verify that the safety relief valve has lifted by measure-

ment, the test cap 3 is fitted with an extension bracket 39 on which is mounted a dial indicator gauge 40. The dial gauge must be zeroed before commencing the test, and when movement is detected the safety relief valve has started to lift.

Where a safety relief valve is fitted to a system which contains inflammable or toxic fluids, suitable gasket seals are used at the upper and lower ends of the hollow hydraulic cylinder, this preventing any of the toxic or inflammable fluid gaining access to the atmosphere during the course of the test. For smaller relief valves, or safety relief valves set at a very low pressure, a similar method may be used, but in such cases the force mechanism may consist of a direct reading spring balance 50 secured to the end of the spindle extension member 30 as shown in Fig. 2, and which may at the upper end be attached to an adjustable support bracket to apply the required load.

Having established the force, by means of either the embodiment of Fig. 1 or Fig. 2, this force is then divided by the sealing area of the seating components such that a pressure is obtained. This pressure is added to the pressure appertaining within the protected system at the time the test is carried out, the sum of these pressures being set pressure of the safety relief valve.

CLAIMS

1. A process for testing in situ the set pressure of a safety relief valve when the valve is subject to an operating pressure of a container or system, which comprises providing a supplementary load to that exerted by the operating pressure which acts counter to a valve loading means and which is of such a magnitude that it will cause the safety relief valve to open.

2. A process according to Claim 1 in which the valve loading means comprises a spring.

3. A process according to Claim 1 or Claim 2 in which the supplementary load is provided by a hydraulic pump and means are provided for measuring the supplementary load.

4. A process according to any preceding claim which comprises the steps of applying an extension member to the spindle of the safety relief valve, applying a test cap over said extension member such that the extension member projects through said cap, applying a hollow hydraulic cylinder to that portion of the extension member which projects beyond the test cap, and retaining said cylinder on said extension member, attaching a force measuring device to said hollow hydraulic cylinder, and attaching a hydraulic pump to said hollow hydraulic cylinder and force measuring device, whereby the operation of said hydraulic pump, a force is built up within the hollow hydraulic cylinder which is registered on the force measuring device, the applied force being increased until the safety relief valve opens so as to indicate the set pressure of the valve.

5. Apparatus for testing in situ the set pressure of a safety relief valve which comprises fitting to a spindle of the valve means for applying a supplementary force in excess of that exerted by the normal operating pressure of the container or system to which the valve is to be fitted and means for measuring the magnitude of this supplementary force required to overcome the set pressure of the valve.

6. Apparatus according to Claim 5 for testing and verifying the set pressure of a safety relief valve, when the safety relief valve is subject at normal operating pressure in a system containing the safety relief valve, said safety relief valve having its spindle fitted with an extension member to which is fitted a test cap through which the extension member projects, a hollow hydraulic cylinder being applied to that portion of the extension member which protrudes through the test cap and being retained thereon by retaining means applied to said extension member and a force-calibrated measuring device, being attached to the hollow hydraulic cylinder, said hydraulic cylinder and measuring device, being connected to a hydraulic pump.

7. Apparatus according to Claim 6 in which the extension member is screwed onto the valve spindle.

8. Apparatus according to Claim 6 or Claim 7 in which the hydraulic pump is hand operated.

9. Apparatus according to Claim 8 in which the hydraulic pump is attached to the hollow hydraulic cylinder and force measuring guage by flexible means.

10. Apparatus substantially described herein with reference to Fig. 1 or Fig. 2.

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